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BULLETIN No. 20—PART IV.

LODE-GOLD DEPOSITS

South-western British Columbia

(Exclusive of Vancouver Island)

by

J. S. STEVENSON

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PREFACE.

Bulletin 20, designed for the use of those interested in the discovery of gold-bearing lode deposits, is being published as a series of separate parts. Part I. is to contain information about lode-gold production in British Columbia as a whole, and will be accompanied by a map on which the generalized geology of the Province is represented. The approximate total production of each lode-gold mining centre, exclusive of by-product gold, is also indicated on the map. Each of the other parts deals with a major subdivision of the Province, giving information about the geology, gold-bearing lode deposits, and lode-gold production of areas within the particular subdivision. In all, seven parts are proposed:—

PART I.—General *re* Lode-gold Production in British Columbia.
PART II.—South-eastern British Columbia.
PART III.—Central Southern British Columbia.
PART IV.—South-western British Columbia, exclusive of Vancouver Island.
PART V.—Vancouver Island.
PART VI.—North-eastern British Columbia, including the Cariboo and Hobson Creek Areas.
PART VII.—North-western British Columbia.

By kind permission of Professor H. C. Gunning, Department of Geology, University of British Columbia, his compilation of the geology of British Columbia has been followed in the generalized geology represented on the map accompanying Part I. Professor Gunning's map was published in "The Miner," Vancouver, B.C., June–July, 1943, and in "The Northern Miner," Toronto, Ont., December 16th, 1943.

SOUTH-WESTERN BRITISH COLUMBIA.

INTRODUCTION TO PART IV.

Prospecting may be more intelligently undertaken and a greater measure of success assured if the prospector, scout, or engineer has some knowledge of the mining history, general geology of an area, and of features of the known gold properties, both producers and non-producers, in an area. A knowledge of the many features common to gold-quartz veins in the south-western part of the Province will also be useful.

One of the best ways to prepare for prospecting in an area about which little is known is first to study the known ore deposits in a mineralized area near-by. A knowledge of the mineralogy, structure, and rock associations of proven gold deposits permit intelligent search for similar conditions in undeveloped areas. A knowledge of how veins look when high-grade, marginal, or non-economic is also of value to the prospector. With this in mind, the geology and gold deposits of the various mineralized areas in the south-western part of the Province are described in detail, so that the prospector or scout may have the pertinent information on the area nearest to the one he intends to prospect, and areas for further prospecting are suggested.

In this publication a brief general statement concerning the geography and the lode-gold production of South-western British Columbia is followed by some general conclusions about the occurrence of gold-quartz veins in relation to batholith areas and some ideas about prospecting near them. More detailed discussion of the geology and mineral deposits follows under four main headings, referring to four principal regions into which South-western British Columbia is subdivided for convenience in this discussion. For each region, areas or belts regarded as of interest to those searching for lode-gold deposits are discussed and references are made to many of the prospects in the less well-known sections.

GENERAL STATEMENT.

Lode deposits of South-western British Columbia have yielded more than 2,000,000 oz. of gold, of which more than 80 per cent. has come from the Bridge River camp, now the most productive lode-gold camp in the Province. Gold recovered as a by-product from copper ore of the *Britannia* mine has amounted to about 14 per cent. of the total, and the copper-gold ores mined between 1896 and 1919 at *Vananda* on Texada Island account for more than 3 per cent. of the total. The *Vidette* mine has produced more than 1 per cent. of the total, and several other properties have produced smaller amounts of gold.

South-western British Columbia, as discussed in this publication, lies between 49° and 52° north latitude, includes the mainland coast and adjacent islands, but not Vancouver Island, and extends east to an irregular line which forms the eastern boundary of the Clinton, Ashcroft, and New Westminster Mining Divisions. For convenience in the following discussion South-western British Columbia is divided into four main regions—the coast and islands, the lower mainland, the eastern flank of the Coast Range, and the region east of the Coast Range; which will be discussed in that order.

The Clinton, Lillooet, Ashcroft, and New Westminster Mining Divisions, and Vancouver and some islands in the Nanaimo Mining Division, are included in the regions discussed. The geography of this part of British Columbia is represented on maps, at various scales, shown in the following list. These maps are obtainable from the Chief Geographer, Department of Lands, Victoria, B.C.

Map No.	Year of Issue.	Title.	Scale.	Per Copy.
		LAND SERIES.		
1K	1925	South-western Districts of British Columbia, Commercial and Visitors	7.89 m. to 1 in.	$0.50
2S	1914	New Westminster and Yale Districts	4 m. to 1 in.	.50
2C	1929	Northerly Vancouver Island (shows adjacent mainland)	4 m. to 1 in.	.50
2D	1923	Powell Lake	4 m. to 1 in.	.50
2S	1924	Bella Coola (preliminary)	4 m. to 1 in.	.50
		PRE-EMPTORS' SERIES.		
3F	1934	Chilcotin	3 m. to 1 in.	Free
3G	1935	Quesnel, contoured	3 m. to 1 in.	Free
3K	1938	Lillooet	3 m. to 1 in.	Free
		MISCELLANEOUS.		
P.W.D.	1939	Highway and Travel Map of British Columbia	20 m. to 1 in.	$0.35
M.D.	1939	British Columbia Mining Divisions and Mineral Survey Districts (shows locations of Mining Recorders' offices)	50 m. to 1 in.	Free
...	.....	Departmental Reference Maps (a series of sheets which covers the whole Province), "Blue" or "Ozalid" prints at scales ½ mile, 1 mile, or 2 miles to 1 inch	.....	$1.00 per sheet
...	.....	Departmental Mineral Reference Maps (covering the principal mining areas of the Province), "Blue" or "Ozalid" prints	1,500 ft. to 1 in.	$1.00 per sheet

GENERAL FEATURES OF A FAVOURABLE PROSPECTING AREA.

Most of the gold-quartz veins in the south-western part of the Province, in common with most gold-quartz veins elsewhere in the world, are found either in or close to batholiths or stocks of granitic rocks. This common association of gold-quartz veins and intrusive rocks supports the theory that the gold-bearing solutions, from which the vein-matter was deposited, originated in the intrusive rocks or in related sources deeper in the earth's crust. The actual source is hard to prove, and although in some places granitic rocks close to quartz veins have been proven to be the actual sources of the vein-solutions a source much deeper within the crust is generally accepted as more probable. Whatever the actual source, the close relationship of gold-quartz to small batholiths and stocks is almost universal. It does not follow that gold-bearing deposits occur in or near all small granitic batholiths or stocks, but the presence of such intrusives indicates that conditions may have been favourable for the production of vein-solutions. Therefore, search should be made in and close to such intrusives for "colours" or "float" and for an environment of rock-types favouring the development of breaks in which vein-matter could have been deposited from the solutions.

Breaks, either fractures or shear-zones, which veins may follow, tend to form where rock-types of different competency or physical characteristics are found. The breaks may follow or may cross the contacts of the different rock-types. The nature of a break which crosses a contact may differ in the different rock-types; it may be a wide shear-zone in a weak rock such as schist or schistose greenstone, and a narrow shear in a stronger rock such as a granite.

Rocks of different physical characteristics are common in the contact areas of batholiths, both within and on the outer side of a contact. On the batholith or inner side of the contact, older rocks may be found as inclusions or pendants in the batholith, giving a physical contrast in rock-types. Outward from the contact (away from the

batholith) stocks and dykes cutting the older rocks give the contrasts in physical characteristics of rocks necessary for the formation of good breaks. The favourable zone is apt to be wider on the outer than on the batholith side of the contact, since in general a batholith contact dips outwards towards the older rocks, and therefore a heterogeneous assemblage of rock-types tends to extend a greater distance from the contact into the older rocks than into the batholith.

Experience has shown that the full length of any contact-zone will not be productive. After a mining camp has been established and numerous underground workings are available for study, correlation of studies of the surface and of the underground workings frequently demonstrates why producers are concentrated at one or several places but are not found continuously along the contact-zone. Before the controlling factors have been recognized there may be little to guide the prospector to the most favourable parts of a contact-zone. However, it can be said that, in general, an embayment or the vicinity of a bend is more favourable than a section in which the contact is approximately straight.

COAST AND ISLANDS.

This part of South-western British Columbia extends southerly from Seymour Inlet to Howe Sound, and includes the mainland coast and the coastal islands, but not Vancouver Island.

Steamers of the Union Steamship Company and of the B.C. Coast Service of the Canadian Pacific Railway call regularly at many ports at which small boats may be hired for local transportation. Short stretches of road are found about the more populous centres.

The topography is rugged and in general is characterized by steep mountains rising from the shore, which is indented by deep narrow inlets. The larger stream-valleys found at the heads of the many inlets give access for several miles inland.

The climate is mild. The average annual precipitation ranges from 35 to 95 inches. The hillsides are covered with a heavy growth of timber, and mine-timber is abundant.

Properties on or close to tide-water have the advantage of being able to ship by water to the Tacoma smelter. The demand of this smelter for siliceous flux has occasioned search for siliceous ore of shipping grade but the quantity shipped has not been great.

SEYMOUR INLET.

At the *Silta* (*Nugent*) property, on the south side of Seymour Inlet, some small high-grade lenses of gold-quartz ore have been found in argillaceous sediments. Several veins have been explored by surface workings, largely made in 1938, and subsequently some ore was mined. The workings are not extensive but the property is reported to have produced more than 600 oz. of gold.

LOUGHBOROUGH INLET-PHILLIPS ARM.

This area includes a part of the coast and adjacent islands that extends south-easterly from Loughborough Inlet past Phillips Arm to Frederick Arm and includes East Thurlow Island and Sonora Island. Production has come principally from the western side of Phillips Arm and the northern part of East Thurlow Island.

History.

Prospecting and mining activity was greatest in this section between 1897 and 1899. At the time a few mills operated in the area and one property, the *Doratha Morton*, has the distinction of having operated the first cyanide-mill in the Province.

In 1898 activity began to decline with prospectors leaving this section, probably for the Klondyke, and there was little activity until the thirties, when prospecting, development, mining and milling were again renewed on several properties.

A 10-ton mill was built in 1934 and two small lots of concentrates were shipped to Tacoma in 1935 and 1936 from the property of the Thurlow Gold Mines, Limited. A 25-ton mill was built at the *Douglas Pine* in 1940 and a small tonnage was treated.

Production.

Total production from seven properties has amounted to 5,821 oz. of gold from 13,702 tons of ore; that is, ore with an average grade of 0.42 oz. of gold per ton. Shipments from individual properties ranged from 2 to 10,000 tons. The most recent activities were in 1940 when a small amount of stoping was done on the *Alexandria* and small amounts of ore were mined and milled on the *Douglas Pine*.

Geology and Gold Deposits.

Map 65A, Coast and Islands, by J. A. Bancroft, published in 1915 by the Geological Survey, Canada, in Memoir 23, and Map 196A, Vancouver Sheet, published in 1928, also by the Geological Survey, represent the geology of this part of the coast. The mapping does not extend far inland from the shore-line.

This part of the coast is well within the western margin of the Coast Range batholith. Several isolated areas of older rocks are shown in a belt, about 5 miles wide, which extends north-westerly from Sonora Island to Loughborough Inlet a distance of 18 miles. These areas of older rocks probably represent the roots of roof-pendants now largely destroyed by erosion.

The older rocks include argillaceous sediments and volcanics that have been minutely folded and, in many places, the argillites in particular have been changed to schistose rocks. Limestone pods, found at several points, have been changed by contact metamorphism to rocks consisting mostly of sulphides and high temperature silicates. The foliation of the rocks strike north-westerly to westerly with the trend of the belt.

The rocks of the batholith, intrusive into the older rocks, are all granitic, ranging from granite to diorite with quartz diorite the common type.

Mineralized Belt.

In this part of the coast there is a concentration of gold-bearing lode deposits, which coincides with the belt of older rocks and was no doubt localized by them. The deposits are veins in fractures and shear-zones along which there has been more or less replacement of wall-rock. Not all the deposits are in roof-pendant rocks, but those in the granitic rocks are not far from the contacts.

The mineralized belt probably represents a zone of weakness, along which faulting has occurred, between the incompetent rocks of the roof-pendant, now represented only by its roots, and the adjacent massive batholithic rocks. Bancroft (1913, p. 111) states that the *Alexandria* and *Doratha Morton* are on a north-westerly-striking fault which intersects the granite of that district.

Veins.

Gold is found in quartz veins, usually associated with small quantities of sulphides, and is rarely found if sulphides are not present. Pyrite is the commonest and usually the most abundant sulphide; small amounts of chalcopyrite, sphalerite, and galena are sometimes found. Samples of relatively pure pyrite have assayed as much as 5.5 oz. of gold per ton.

Most of the deposits are bedded quartz veins striking west-north-westerly with the formations. The vein-minerals occur in lenticular masses, one of which may die out along the strike and another may shortly come in.

Environment of Veins.

The gold-quartz veins may lie wholly within granitic rocks of the batholith, along the contact of granitic rocks with intruded rocks or dykes, or wholly within the argillites or greenstones of the roof-pendant areas.

Wholly in the Batholith.—Quartz veins and lenses striking west-north-westerly in granodiorite are found on the property of Thurlow Gold Mines, Limited, where they attain widths of 3 to 7 feet, and on the *White Pine* property, where they attain widths of 6 to 20 feet. A quartz vein 2 to 5 feet wide is found as an offshoot from a pegmatite dyke in granitic rocks on the property of the Hayden Bay Gold Mines, Limited, on Heydon Bay. Some of the widest veins are barren, but some of the narrower veins carry more sulphides and better gold values.

At Contacts of Dykes with the Batholith.—Quartz veins, striking north-easterly, are found in fractures and narrow shear-zones along the contacts of hornblende diorite of the Coast Range batholith and acidic dykes on the property of Loughborough Gold Mines, Limited. It may be noted that these are the only north-easterly-striking veins of consequence so far found along the mineralized belt. This property lies towards the south-western margin of the belt and the north-easterly-trending breaks, occupied first by the acidic dykes and followed later by the vein-quartz, may represent branches from the general west-north-westerly lines of shearing of the main belt.

At Contact of Argillites and Granitic Rocks.—On the *Enid-Julie* property numerous quartz bands and lenses alternating with schist are found over a width of 35 feet in a marginal contact-zone between granodiorite and argillites and greenstone schists. The individual quartz lenses attain widths of 2 to 5 feet and may extend several hundred feet along the strike, which is west-north-westerly.

Wholly in Argillites.—On the *Doratha Morton* property lenses and stringers of quartz are found along a north-north-westerly-striking shear-zone 100 feet wide that follows the contact between argillaceous schists and granitic rocks of the Coast Range batholith. Individual quartz lenses are from 1 foot to 5 feet wide.

Lenses of quartz of very great width are found bedded with argillites on the *Blue Bells* property. The amount of quartz is very large, but the mineralization slight and gold values low. In 1919 the Ladysmith Smelting Corporation investigated the property as a possible source of siliceous flux, hoping to find quartz with sufficient gold values to pay the cost of mining and handling.

Suggestions for Prospecting.

The several properties found to date, some of which have produced, suggest the possibility that other, perhaps better, properties may exist along the same structural feature that has determined the position of the known properties. The structural feature here is the west-north-westerly-trending belt, about 5 miles wide, characterized by many small areas of greenstones and associated sediments. Easily recognizable geological features or structures that serve to localize the known mineral deposits in the belt have not been found; however, the nature of the known properties may be used indirectly in determining where to prospect along the belt.

Production has been greatest at Loughborough Inlet and in the vicinity of Phillips Arm. South-easterly from Phillips Arm production has been smaller and prospects seem less promising. As localizing factors have not been recognized at Phillips Arm and Loughborough Inlet it may be that the north-westerly part of the belt is more favourable than the remainder; therefore the writer suggests prospecting along the belt between Phillips Arm and Loughborough Inlet. It is possible that a change in economic conditions may improve the ore positions of some of the former producers, on some of which a fair tonnage of low-grade material has been indicated.

References.

Bancroft, J. A. (1913): Geology of the coast and islands between the Strait of Georgia and Queen Charlotte Sound, B.C.—*Geol. Surv., Canada*, Mem. 23.

LeRoy, O. E. (1908): Preliminary report on a portion of the main coast of British Columbia and adjacent islands—*Geol. Surv., Canada*, Publication No. 996.

O'Grady, B. T. (1936): Mainland coast and islands—*Minister of Mines, B.C.*, Ann. Rept., pp. F 17–F 25.

Richmond, A. M. (1934): Shoal Bay—Phillips Arm Section—*Minister of Mines, B.C.*, Ann. Rept., pp. F 7–F 11.

QUADRA ISLAND.

Quadra Island lies immediately east of Campbell River on Vancouver Island. It is best known for the several small copper properties and prospects found mainly along what is known as the lime-belt. Of the two dozen properties on the island half are on the lime-belt.

Production has been recorded from six properties, of which four are straight copper deposits; the *Lucky Jim* has copper-gold ore, and one, the *Geiler*, straight gold ore. In all, 248,848 lb. of copper and 239 oz. of gold have been produced.

In the gold-copper ores the gold content is about 0.45 oz. per ton, with about 2.5 per cent. copper. In the straight gold ore, the gold content ran slightly over ½ oz. per ton for a total production of slightly over 100 tons.

Both the gold properties, the *Lucky Jim* and the *Geiler*, are in the lime-belt. This belt extends for 10 miles north-westerly across the island from Open Bay to Granite Bay, with an average width of 1 to 2 miles. It consists mainly of limestone with small amounts of intercalated greenstone. The lime-belt is flanked on the north by granitic rocks of the Coast Range batholith and on the south by greenstones.

The *Lucky Jim*, along with the many copper properties in the belt, is a contact metamorphic type of deposit, in limestone close to granitic rocks. It is characterized by irregular lenses of sulphides usually not more than 2 feet wide, containing abundant pyrrhotite with lesser amounts of chalcopyrite and pyrite. Of the many contact metamorphic deposits on the belt the *Lucky Jim* is the only one carrying gold.

The *Geiler* belongs to a group characterized by small gold-quartz veins found in shear-zones in the greenstones of the belt. A small quantity of ore, averaging slightly over ½ oz. of gold to the ton, has been mined.

Several copper properties have been found on the east and west coasts of the island south of the lime-belt. These consist mainly of chalcopyrite or chalcocite in shear-zones in greenstones. They do not contain any gold of significance.

Reference.

Cairnes, D. D. (1913): The lime belt, Quadra (South Valdes) Island, B.C.—*Geol. Surv., Canada*, Sum. Rept., pp. 58–75.

TEXADA ISLAND.

Distribution of Properties.

The part of the island northerly from a line between Gillies Bay on the west and Pocahontas Bay on the east coast has been extensively prospected. Most of the mines and prospects found to date are in this part of the island. At least 37 mines and prospects are found in an area of 36 square miles. In the southern part of the island, measuring 85 square miles, only one prospect has been reported.

Southern Part of the Island.

The rugged and heavily wooded southern part of the island is served by few trails and no roads. It is underlain mainly by greenstone with two small areas of quartz

diorite, one near Pocahontas Bay, 1.5 square miles in area, and the other near Long Beach, 2.5 square miles in area. Certain features of the geology suggest that the southern part of the island could be prospected to advantage. The difficulty of access, however, is a serious drawback.

Northern Part of the Island.

Much less rugged and not so heavily wooded as the southern part, the northern part of the island is served by numerous roads and trails. It is underlain by greenstone, a belt of limestone 1 to 2 miles wide, and numerous small areas of intrusive rocks. The geology of this part of the island is represented on a map, scale of 2 miles to 1 inch, which accompanies Memoir 58 (McConnell, 1914).

Copper mines which have produced gold as a by-product comprise most of the mines on the island. Only a few gold-quartz veins have been found and the gold production from such has been very small. Three large magnetite-iron deposits are found on the west coast of the island.

Copper-gold Deposits.

The main copper-gold properties are of the contact metamorphic type and are found in limestone adjacent to intrusives related to the Coast Range batholith. The ore minerals are mainly bornite and chalcopyrite, accompanied by a gangue consisting mainly of the high temperature silicates wollastonite, garnet, and actinolite. The ore is usually in the form of lenses with great vertical extent.

Production and Grade.—The copper-gold mines on Texada Island have produced 18,451,730 lb. of copper, 487,020 oz. of silver, and 66,974 oz. of gold from 366,925 tons of ore. This represents production from eight copper properties; of these five produced over 50,000 lb. of copper, and two, the *Marble Bay* and *Cornell*, over 1,000,000 lb. The average grade of ore for the total production is 0.18 oz. of gold per ton and 2.5 per cent. copper, but the grade has ranged from 6.6 per cent. copper and 0.4 oz. of gold for the smaller producers to 2.3 per cent. copper and 0.16 oz. of gold for the larger producers. The gold content was approximately proportional to the copper content.

Gold-quartz Veins.

A few gold-bearing quartz veins have been found on the island, but the veins are small and low grade; consequently the production has been small. A few of the prospects have yielded a few hundred pounds of bonanza ore each, but further search has failed to produce bonanza ore in important quantity.

The deposits are quartz veins and silicified shear-zones, mainly in greenstone. The few known veins are small, some attaining widths of 3 to 5 feet, and widely separated; no localising structural controls of the gold veins are evident.

Mineralization.—The veins contain, in addition to free gold, small amounts of pyrite, chalcopyrite, sphalerite, magnetite, and galena.

Production.—At least eleven prospects have been found and a small production is reported from four of them. The production from two properties, slightly over 300 tons, is reported to have yielded about 160 oz. of gold. Excepting on the *Gem* and *Marjorie*, the amount of underground work on these properties is small.

It is reported that $2,000 was recovered from a shallow working on the *Gem* (*Nutcracker*) in 1896. This property is developed by a 150-foot shaft with crosscuts and drifts on the veins, but no quantity of ore has been found. A 200-ton mill was built in 1926 but never operated. On the *Marjorie* free-gold ore taken from a hole 7 feet square by 6 feet deep is reported to have yielded $6,500 in gold.

Suggestions for Prospecting.

As mining activity in the producing section dates back to 1896, it is probable that the surface outcrops in the vicinity of the producing copper-gold mines have been examined many times. Probably future finds in this section will be made as a result of unwatering the old copper-gold mines and carrying on underground exploration by diamond-drilling and the driving of levels; surface prospecting by individual prospectors is less likely to be successful.

The work on the known gold-quartz veins has not been very successful. Rock-outcrops are fairly numerous on the island, and the north end in particular is not difficult to prospect. It is doubtful if further surface prospecting will find other gold-quartz veins of minable width and grade.

Reference.

McConnell, R. G. (1914): Texada Island, B.C.—*Geol. Surv., Canada*, Mem. 58.

LASQUETI ISLAND.

Lasqueti Island, just off the south-westerly end of Texada Island, has an area of 25 square miles, consisting chiefly of low, rounded, well-wooded but rocky hills.

Production.

Production, mainly from three copper-gold properties, has amounted to 831 tons, averaging 3.9 per cent. copper and about 0.2 oz. of gold per ton. Some ore shipments have been as high as 0.7 oz. of gold per ton and 16 per cent. copper. The gold values are proportional to the copper content.

Geology.

Greenstones underlie the greater part of Lasqueti Island, but quartz diorite, 2 miles long and 1 mile wide, extends northerly from Scottie Bay to False Bay.

Location of Properties.

The known properties lie towards the north end of a tongue of quartz diorite where it projects into the greenstone. Some properties are in the quartz diorite practically on the contact, others are in the greenstone a short distance from it.

Nature of Mineralization.

Lenses and stringers of chalcopyrite and pyrite replacing crushed rock are found in shear-zones, which range from a few inches to several feet wide and may be traced for several hundred feet. Although lenses of chalcopyrite up to 4 feet wide have been found and stoped, most lenses are much narrower and the distribution of high-grade ore along the shears is so erratic that as yet only a small amount of ore has been found.

Long Shear-zone.

Mackenzie (1921, page 56) describes a persistent shear-zone, 2 to 4 feet wide, that has been traced nearly continuously for 900 feet cutting through both quartz diorite and greenstone. This zone lies about 1,500 feet south-easterly from the workings on the *Venus*. It trends north by east and locally is mineralized with chalcopyrite.

Because of similarity in strike and mineralogy to the mineralized zones on the other properties, further prospecting of this shear might be warranted.

Suggestions for Prospecting.

The success of further prospecting on Lasqueti Island lies in part in further exploration of the known shear-zones. The north-north-easterly-striking shear-zones in or close to the contact of the quartz diorite seem to hold most promise.

Reference.

MacKenzie, J. D. (1921): Lasqueti Island—*Geol. Surv., Canada,* Sum. Rept., p. 50.

LOWER MAINLAND.

The part of the lower mainland between Harrison Lake and Jervis Inlet contains numerous copper properties and one very important producer. Of the gold prospects only *Ashloo,* north of Squamish, has produced gold in any quantity.

Access.

The southern and eastern parts of the lower mainland are accessible from the Fraser River, Harrison Lake, and Lillooet Lake, and the western part from the coastal waters. From Squamish, at the head of Howe Sound, the Pacific Great Eastern Railway runs north-easterly through the area.

General Geology and Mineralization.

Geologically, the area represents a section across the main Coast Range batholith. Much of the bed-rock is granitic, but there are also many pendant-areas of rocks older than the intrusives. The older rocks, which include sericite and chlorite schists, greenstones, tuffaceous sediments, and lenticular bodies of limestones, are irregularily scattered and do not form extensive well-defined belts.

The copper deposits are either replacements along drag-folds and shear-zones in schistose, rocks, closely related to feldspar porphyries, or high temperature replacements of limestone at contacts with batholithic or stock-like bodies. The principal ore mineral is chalcopyrite. Mineralized drag-folds and shear-zones have so far proven to be the most productive.

SQUAMISH-PEMBERTON.

Belt along Pacific Great Eastern Railway between Pemberton and Squamish.

The Pacific Great Eastern Railway between Squamish and Pemberton cuts across the main Coast Range batholith and any west-north-westerly-trending structures associated with the batholith. The ruggedness of the country and numerous ice-fields have prevented prospecting north-westerly and south-easterly from the railway.

Geology.

The rocks of this area consist mainly of Coast Range granitic rocks and narrow bands of older stratified rocks that include schists, quartzites, argillites, limestones, and greenstones. Tertiary and recent lavas are common.

Mineralization.

About ten properties have been found and worked in this section but, excepting one gold property, the *Ashloo,* they are all either lead-zinc or copper prospects.

The *Ashloo* property, on Ashlu Creek, is about 28 miles by road and trail north-north-west of Squamish. It is in an area of strong relief in which the mountain-sides are steep, heavily wooded, and the streams characterized by many canyons.

The deposit lies well within the Coast Range batholith, and consists of bands of quartz in a long, wide shear-zone in the granodiorite of the batholith. The shear strikes north-north-easterly and dips 23 degrees westward, tending to follow an irregular lens of basic dyke-rock. The quartz ranges from a few inches to 6 feet in width and the shear is of comparable width; the shear is not continuously quartz-bearing. The quartz contains intermittent concentrations of pyrite, chalcopyrite, and

occasionally pyrrhotite. The gold content of the vein is proportional to the sulphide content and assays of several ounces in gold have been obtained from sulphide-rich vein-matter.

In the period 1932–39 ore mined amounted to 15,047 tons and yielded 6,396 oz. of gold, 7,154 oz. silver, and 66,187 lb. copper.

In addition to surface workings, underground workings with a total length of several thousand feet include an adit, several other levels, connecting winzes, and a raise. A 25-ton mill was built in 1936. The mine closed down in 1939.

REFERENCE.

O'GRADY, B. T. (1935): Annual Report, Minister of Mines, B.C., pp. F 1–F 6.

AGASSIZ.

Many copper prospects, but no gold prospects, have been found in the vicinity of Agassiz. The deposits are mainly small iron and copper sulphide replacements in limestone lenses, close to bodies of intrusive rocks, with the principal values in copper. Ore has been shipped from one property—the *Empress*—from which 100 tons, shipped in 1917, contained 14,000 lb. of copper.

On the *Lucky Four* group, near Wahleach Lake, high in the Cheam Range, south-easterly from Agassiz, chalcopyrite mineralization has been found in metamorphosed limestone. The information available does not indicate that appreciable gold values accompany the copper mineralization.

HARRISON LAKE-FIRE LAKE.

Harrison Lake extends for about 35 miles northerly to north-westerly from Harrison Hot Springs due north of Agassiz. Fire Lake is about 12 miles north-westerly from Tipella, near the northern end of Harrison Lake. The original Cariboo Road was built up the Lillooet River from Douglas, near the northern end of Little Harrison Lake, and the surrounding country was prospected many years ago.

Gold has been found at the *Providence* (*Province*) property, on the west side of Harrison Lake about 28 miles northerly from Harrison Hot Springs, and at several properties on the north side of Fire Lake.

Somewhat indefinite statements indicate that ore from the *Providence*, shipped to smelters at Tacoma and Everett about 1897 and 1898, averaged $20 to $34 per ton in gold and silver. From the brief descriptions of the property available, it appears that quartz veins containing some pyrite were found. The property has been explored by a shaft and several adits.

The Fire Lake area is reached by 16 miles of trail north-westerly from Tipella at the northern end of Harrison Lake. About 40 years ago the finding of scattered bunches of high-grade ore in veins north of Fire Lake started a short period of intense prospecting and on the *Money Spinner* a 50-ton concentrator was built. It is reported that only 50 tons of ore was milled. Since then activity in the area has been slight, except between 1930 and 1934, when several men did surface prospecting on four properties and underground work on one.

The low values obtained from the numerous samples taken indicate that though quartz veins are abundant and of a fair width their gold content is small.

Several properties have been staked on the northern side of Fire Lake, mostly on well-defined gash-veins in massive greenstone. The gash-veins range up to 2 feet in width and up to 80 feet in length and strike from north-easterly to easterly. A well-defined fissure-vein on the *Money Spinner*, striking north-south, averages 4 feet in width and has been traced by underground and surface workings for several hundred feet. The quartz in these veins is slightly mineralized with pyrite and chalcopyrite and samples across mining widths assay from traces to less than a ⅛ oz. of gold per ton.

CHILLIWACK RIVER.

The *Mountain Goat* and the property of the Sleese Creek Mining and Development Company, Limited, on Slesse Creek are gold prospects. On the *Mountain Goat* the gold is found associated with pyrrhotite in narrow quartz veins that cut sediments near their contacts with a stock of diorite. High-grade mineralization is very erratic and continuous ore has not been found. The property of the Sleese Creek Mining and Development Company, Limited, is close to the western border of a large area of batholithic rocks and includes granodiorite and quartz diorite, in which narrow quartz veins containing pyrite and small amounts of gold have been found.

The fact that small amounts of very rich gold ore have been found on the *Mountain Goat*, and that over a period of years high-grade ore was shipped from the Boundary Red Mountain Company's mine on Slesse Creek, just across the border in the United States, suggests the advisability of further prospecting in the area, particularly northerly and southerly along the contact-zone of the large area of granodiorite which lies east of Slesse Mountain.

Molybdenite has been found at the north-western end of Chilliwack Lake, and the *Dolly Varden*, a lead-zinc prospect, is at the southern end.

HOPE.

In the area about Hope two gold properties of some promise have been found:—

On the *Aufeas*, on Silverhope (Silver) Creek, about 6 miles south-west of Hope, quartz veins contain abundant arsenopyrite, with which gold is associated. The veins are found in quartz diorite in a large area of batholithic rocks some distance from the contact with the older rocks. Further prospecting is warranted in a direction eastward towards the older rocks.

On the Hillsbar Creek gold claims, 14 miles north of Hope, north-westerly-striking quartz veins have been found bedded in slates at distances between 100 and 200 feet from a granodiorite contact. The veins pinch and swell, and have an aggregate width, for 3 veins, of 4 feet. Some free gold has been found, but the mineralization is scanty. Very little development-work has been done on the property.

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EASTERN FLANK OF COAST RANGE.

SIWASH CREEK-COQUIHALLA RIVER-SKAGIT RIVER.

Delineation of the Area.

This area, lying along the eastern flank of the Coast Range, extends south-south-easterly from Siwash Creek near Yale, across the Coquihalla River, to where the Skagit River crosses the International Boundary. The area is 42 miles long by about 15 miles wide, and includes the following mineralized sections: Siwash Creek, Coquihalla Gold Belt, and Skagit River.

General Geology.

Some of the geological features found in this area may represent the southerly extension of similar features found in the Bridge River area. The gold mineralization does not duplicate that found in the Bridge River, but it is similar in that it is found close to the eastern margin of the Coast Range batholith and mainly where a change takes place in the trend of the formations. However, any correlation between the two areas must bridge a large gap of country in which the geology is imperfectly known, and in which no important gold mineralization has been recorded.

Sediments.—The oldest rocks consist mainly of andesitic lavas, intercalated with argillites and ribbon-chert, all of which strike northerly. They resemble the rocks variously referred to as the Fergusson or Bridge River series in the Bridge River area and the Cache Creek series throughout Central British Columbia.

To the north-east, the oldest rocks in this area are overlain by a wide belt of black, slaty rocks, comprising the Ladner slate-belt, which is overlain by tuff, agglomerate, sandstone, and argillite of the Dewdney Creek group, overlain in turn by conglomerate of the Jackass Mountain group, the pebbles in the conglomerate are of granitic rock.

Serpentine Belt.—A narrow zone of rocks in which serpentine is a conspicuous member lies between the volcanics and ribbon-cherts of the Cache Creek series to the south-west and the slates of the Ladner slate-belt on the north-east. This zone, referred to as the "serpentine-belt," because of the continuity of serpentine in it, is of special significance because many of the gold deposits of the area are found along the contact bodies of serpentine and other members of the belt.

The belt does not exceed a mile in width, averaging about half a mile, and extends north-north-westerly from a point 12 miles south-west of Jessica nearly to Boston Bar, a distance of 39 miles. It ranges in strike from north-north-westerly at the south to north-westerly at the north. The main gold properties in the serpentine-belt are found a few miles north-west of Jessica when the strike of the belt changes from north-westerly to north-north-westerly.

Along the belt, serpentine forms a close succession of dyke or sill-like masses in the associated rocks. These rocks include andesitic volcanics, tuffaceous sediments, and intrusive porphyries.

Cairnes thinks (1929, p. 178) that the serpentine represents peridotite, that, prior to its serpentinization, was intruded as a sill-like mass or succession of masses along a zone of weakness or shearing. The shear formed within a zone of relatively incompetent volcanics and tuffaceous sediments at the top of the Cache Creek series where they lay against a more competent set of rocks composed chiefly of strong ribbon-cherts. The intrusion of this rock marked the beginning of the long line of Coast Range intrusions, which included the various batholiths, porphyry dykes, and, lastly, mineralizing solutions.

Granitic Rocks.—The granitic rocks of the area include a notably crushed and foliated gneissic granite and granodiorite locally known as the Custer granite and younger granitic intrusions, consisting of massive granite, granodiorite, quartz diorite, and diorite. The gold deposits lie 2 to 5 miles easterly from the eastern margin of these intrusives.

Porphyries.—Many smaller acid intrusives, mainly porphyries, are found as dykes and sills in sedimentary rocks. Some of the intrusives are Jurassic in age and contribute granite detritus to the early Lower Cretaceous Jackass Mountain conglomerate, others may be of Tertiary age. The intrusives trend north-westerly and many have gold deposits associated with them.

General Structure.—The folds in the stratified rocks, faults in both stratified and massive rocks, and foliated structures in some of the granitic rocks all have a general north-westerly trend. This trend follows that of the eastern contact of the Coast Range batholith. The contact lies west of Harrison Lake and Lillooet River.

Rocks up to and including the early Lower Cretaceous, are highly deformed, but the younger rocks are not.

Siwash Creek Section.

Several prospects, including the *Roddick, Jubilee, Coronation, British Gold,* and *Golden Eagle,* are found at the bend of Siwash Creek, in an area 6 miles long by 5 miles wide.

This section is reached by a cable crossing over the Fraser River near Yale, thence by trail up Siwash Creek for about 4 miles.

On Siwash Creek, as has been the case elsewhere, placer-miners who had been washing stream-gravels for gold found gold-bearing lode deposits. The discoveries made about 1891–92 were quartz veins in and near porphyry dykes. In 1896, early in the prospecting of these properties, a 3-stamp mill was built and in 1905 two larger mills were built. A renewal of activity occurred in 1911, but little has been done since.

The rocks include slates, garnet-schists, mica-schists, siliceous schists, quartzites, and crystalline limestone, all cut by Coast Range intrusives and acid dykes. A band of serpentine 400 feet wide can be traced for 3 miles.

Gold-bearing quartz veins have been found in porphyry dykes and at the contacts of the dykes with slate. The distribution of the gold within the veins is very erratic. The quartz contains small amounts of pyrite, chalcopyrite, and galena. Parts of the known quartz veins are rich, but are not continuous enough to make ore.

Suggestions for Prospecting.—Knowing that rich gold-pockets have been found in the veins of the district, it is reasonable to search for additional veins, hoping that in some may be found rich pockets sufficiently closely spaced to make ore. Inasmuch as the veins are definitely related to porphyry dykes, areas in which porphyry dykes are numerous should be studied. Because of the close spatial relationship of the gold deposits with both the porphyry dykes and the serpentine-belt in the Coquihalla gold-belt to the south, areas of porphyry dykes where close to, or in, serpentine should be examined. Quartz veins found in such an environment might yield gold ore. Because of a distinct bend in the serpentine-belt between Siwash Creek and Jessica on the Coquihalla gold-belt, the writer suggests prospecting between Siwash Creek and Jessica.

Coquihalla Gold-belt.

This section crosses the Coquihalla River near Jessica station on the Kettle Valley branch of the Canadian Pacific Railway and extends north-westerly for 5 miles and south-easterly for 3 miles.

The various properties on the belt are reached by short roads and trails from Jessica, which is 15 miles by railway from Hope.

History.

Before the discovery of the gold properties in the serpentine-belt, quartz veins and siliceous zones in both the Ladner slate-belt to the north-east and the rocks of the Cache Creek series to the south-west had been prospected for several years and from 1916 there had been small intermittent production. In 1928, high-grade gold ore was found on the *Aurum* in a talcose-shear along the north-easterly contact of a band of serpentine. Other discoveries related to serpentine bodies were made north-westerly and south-easterly and for some time the area was actively prospected, but many prospects were promoted beyond their merits, more energy and money being spent in promoting them than in actual prospecting. Between 1916 and 1942 five properties produced ore amounting to 3,102 tons and containing 3,912 oz. of gold, an average of 1.2 oz. of gold per ton.

Properties.

The properties on the belt north-west of the Coquihalla River include the *Aurum, Emancipation, Pipestem, Hope Gold Mines, Ltd., South Fork* group, *Montana* group, *Spider Peak* group, the *Spencer* holdings, the *Keystone* group, the *Mammoth Holdings, Ltd.*, and south-east of Coquihalla River the properties of the *Columbia Metals, Ltd., Reward Mining Company*, and the *Dalhousie Mining Company.*

Types of Ore Deposits.

The ore deposits of the belt may be divided into two groups: (1) Those characterized by gold and sulphides associated with "talc" at the contact of serpentine and other rocks, as exemplified by the *Aurum* deposit, and (2) Gold-bearing quartz veins found mainly in the Ladner slate-belt close to the serpentine-belt, as exemplified by the *Emancipation* deposit.

To date the second type has produced the larger amount of gold.

Associated with Talc.—In several places along the belt the serpentine near its contact with the older rocks has been sheared and largely replaced by talc. The talcose shear, ranging in thickness from less than a foot to several feet, contains several gold-ore bodies. The gold is very unevenly distributed, being found in clusters or veinlets and quite often as polished films along slickensides. The polished films are exceedingly thin and contain a deceivingly small amount of gold. Concentrations of gold or small ore-shoots are related to irregularities or rolls along the contact surface of the serpentine body.

Most of the gold in the talcose shear is free, but in some places it is associated with sulphides, which include pyrite, chalcopyrite, arsenopyrite, pyrrhotite, and nickel sulphides. A small amount of quartz and calcite gangue may be present. Of the sulphides, arsenopyrite is most commonly associated with gold.

The gold-bearing talc is found in or near serpentine contacts, in some places on the north-eastern and in other places on the south-western contact. Since the gold is so erratically distributed finding commercial ore depends on finding a sufficient number of rich shoots closely enough spaced to make some tonnage with payable values.

After the recognition or discovery of gold along serpentine contacts, the serpentine-belt was boomed and many short-lived companies were formed. It is to be inferred from this that considerable prospecting has been done along the serpentine contacts, but it is not known how thoroughly this was done. The *Aurum*, towards the north-western end of the line of properties on the belt, is the one producer from the talc-seam and its production has been small.

Quartz Veins.—The second type of deposit in the belt, namely, gold-bearing quartz veins in the Ladner slate-belt, is the more important. Many quartz veins have been found and prospected; and production from two properties has amounted to 2,226 tons of ore containing 3,117 oz. of gold, or an average content of 1.4 oz. of gold per ton.

The veins contain free gold, arsenopyrite, pyrrhotite, pyrite, and chalcopyrite in small amounts, range in width from a few inches to 10 feet, and strike north-northwesterly with the formation.

In the principal example of this type of deposit, the *Emancipation* (*Dawson*), a low-grade foot-wall vein 10 feet wide and a relatively high-grade, narrow, hanging-wall vein up to 2 feet wide are found along a sheared belt of rocks 50 feet wide between slates of the Ladner slate-belt and Cache Creek volcanics and tuffs. The rock between the veins is laced with many quartz veinlets. An important ore-shoot was found where a flat cross-vein intersected the hanging-wall vein.

The quartz veins of this type are often close to or in porphyry dykes or sills. They are similar in this respect to those of Siwash Creek.

Origin of Quartz Veins and Relation to Serpentine-belt.—The proximity of these veins to the gold occurrences in the talc-seams of the serpentine-belt is probably because both types of deposit are related to a zone of shearing between competent cherts and incompetent upper tuffaceous rocks of the Cache Creek. That is, the mineralizing solutions that resulted in the gold-quartz veins of the Ladner slate-belt close to the serpentine-belt found access by way of the same general zone of shearing that gave access to gold-bearing solutions that deposited gold in the talcose-shears along serpentine contacts. The two types of deposits are different because of the different response by the two physically different host-rocks, serpentine and slate, to the same deforming and fracturing forces.

Suggestions for Prospecting.—The extent of the serpentine or gold belt southeasterly across the Coquihalla River was prospected following the discovery of high-grade ore, but very little was found. It should be noted that placer gold has been found on Sowaqua Creek right where the creek crosses the serpentine-belt. Probably this placer gold came from veins along the belt, and the veins, if found, might contain ore. However, Cairnes (1929, p. 176) suggests that some of the gold is from reworked glacial debris of the main Coquihalla Valley glacier and that the rocks which supplied the gold may have originated, in part, entirely outside the basin of Sowaqua Creek.

The only producers in the Coquihalla gold-belt are at the north-western end of the belt near the *Aurum* and nothing has been found further to the north-west. It is possible that the section between the *Aurum* and Siwash Creek has not been thoroughly prospected. As previously noted on page 20 the strike of the serpentine-belt changes from north-westerly to north-north-westerly a few miles north-westerly from Jessica, near the *Aurum*. Inasmuch as ore-deposits are commonly found where marked changes in structures of the enclosing rocks take place, the general area of the change in the strike of the serpentine-belt, near the *Aurum* and north-westerly towards Siwash Creek, offers possibilities of finding some mineralization.

Skagit River Section.

A large mineralized area is found in part of the Skagit River drainage-basin in British Columbia, in the vicinity of the 23-Mile Camp at the junction of the Sumallo and Skagit Rivers and southerly to the International Boundary. The ores are mainly those of silver, copper, lead, and zinc; however, some of the deposits carry gold in quantities which, though small, might aid in making a property workable. Lack of transportation is a main drawback. Access is by way of the western end of the Hope–Princeton Highway, for 23 miles by poor road from Hope to 23-Mile Camp. Access to the southern part of the area is by pack-trails.

History.—The area first gained prominence in 1910 when a couple of prospectors fraudulently reported finding high-grade gold ore on Steamboat Mountain south of Shawatum (10-Mile) Creek. This stimulated prospecting in the area and since then many prospects of silver, copper, lead, and zinc have been found and have been worked intermittently; small shipments have been made from two silver-lead-zinc properties.

Production.—The Skagit River section has produced, over a period of years, 125 tons of ore containing 11,477 oz. of silver, 26,541 lb. of lead, and 12,163 lb. of zinc. The amount is small, but it must be remembered that the ore was taken out partly by pack-horses and then by truck over 23 miles of poor road.

Geology.—The rocks comprise southerly-trending belts of sedimentary and volcanic rocks, including the Hozameen series exposed on both sides of the Skagit River valley and the Dewdney Creek group lying east of these. The Hozameen rocks include greenstone, chert, slate, and limestone. The limestone, though not as abundant as the other rock-types, is important because it is the host for the replacement deposits of the area.

The rocks of the Dewdney Creek group consist mainly of tuffaceous sediments.

Three masses of granitic intrusive rocks are found in the area, they are mainly granodiorite and quartz diorite. What may be considered to be the eastern contact of the main area of the Coast Range batholithic rocks lies about 10 miles west of the main northerly-trending mineralized belt. Small masses of ultra-basic rock have been recognized north of 23-Mile Camp and north of Shawatum (10-Mile) Creek.

The rocks are folded in north and north-north-westerly-trending anticlines and synclines.

Replacement Deposits.—In the Dewdney series at the *A.M.* property, south-east of the head of Silver Daisy (24-Mile) Creek, pyrite and chalcopyrite with quartz and calcite replace the matrix, in a bed of breccia, and carry values in copper, gold, and silver. In the Hozameen series limestone lenses are replaced by various sulphides, forming different types of deposit. One type, characterized by pyrite, chalcopyrite, sphalerite, arsenopyrite, and galena, with values principally in copper and silver, is represented by the *Silver Bell*, near Silver Daisy Creek, and the *Sunset*, on Galena Creek. Another type, characterized mainly by pyrrhotite, usually contains some chalcopyrite and may contain sphalerite, pyrite, and galena; the values in copper, silver, and gold are low but the gold is more constant than in the other type. Many deposits in the Shawatum (10-Mile) Creek section belong to this group.

Veins.—Mineralized quartz veins, less than 2 feet wide, found in greenstones, cherts, and granitic rocks, carry values mainly in silver and lead but gold is known to occur associated with arsenopyrite. The veins on which most development-work has been done, and from which small shipments have been made, are found in the 23-Mile Camp and in an area of intrusive rocks just east of the camp.

Suggestions for Prospecting.—Prospecting in the area should be devoted to looking for gold-bearing replacement deposits, because, from the nature of the finds so far made in the area, it appears that only in this type of deposit is there any hope of finding a sufficiently large tonnage of ore to warrant improving the transportation facilities.

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ANDERSON LAKE-TATLA LAKE.

DELINEATION OF THE BELT.

A belt of country extending along the eastern flank of the Coast Range from Anderson and Seton Lakes north-westerly for 150 miles to Tatla Lake contains isolated mineral deposits, some of which are near the flank of the Coast Range and others as much as 30 miles east of it. This belt includes the Bridge River area with two major producing mines and other areas in which prospects have been found. The several areas are as follows: The Bridge River area; areas north-west of Bridge River, including the Upper Taseko River, Taseko Lake, Tatlayoko Lake, Perkins Peak, and Blackhorn Mountain sections; and areas east and south-east of Bridge River, including the Cayoosh Creek and Duffey Lake sections.

ACCESS.

The southern part of the belt is reached by motor-road from Shalalth and the northern part from Williams Lake by the Chilcotin road. Shalalth and Williams Lake may be reached from Vancouver by motor-road or by the Pacific Great Eastern Railway from Squamish.

TOPOGRAPHY, FOREST-COVER, AND CLIMATE.

Inasmuch as the full length of the belt is along the eastern flank of the Coast Range it is extremely rugged. Elevations range from the following lake elevations: Anderson Lake, 777 feet; Gun Lake, 2,908 feet; Taseko Lake, 4,400 feet; and Tatlayoko Lake, 2,717 feet, to the mountain-tops, some of which are over 9,000 feet and many over 8,000 feet in elevation. North-east of the headwaters of Tyaughton Creek and of the northern ends of Taseko and Chilko Lakes the mountains give way to the level country of the Interior Plateaux, an extensively lava and drift-covered area, and therefore generally unsatisfactory for prospecting.

The Plateaux area is sparsely wooded with pine, but the areas which are closer to the mountains, and therefore at slightly higher elevation, have a greater abundance of pine and, where high enough, some fir.

In general the climate is agreeable, the summer months warm and dry and the winter months moderately cold. Snowfall is slight and rainfall moderate.

HISTORY.

The history of gold-mining along the length of the belt has hinged mainly on developments in the Anderson Lake-Bridge River section; and therefore the history of the belt is largely the history of these two sections.

As is not unusual the lode discoveries followed placer operations. Placer was discovered in the Fraser at Lillooet in 1859 and shortly thereafter in Cayoosh Creek, Bridge River, and some of its tributaries.

Lode gold was first discovered on the Hurley River in 1882, and in 1896 on Cadwallader Creek on the *Forty Thieves* group. Between 1897 and 1900 most of the more

important properties in the Bridge River area were staked, including the *Lorne, Coronation, Pioneer,* and *Wayside.* From that time to the present the district has gone through several periods of activity and inactivity in prospecting and mining developments.

From the time of discovery until about 1915 desultory mining and milling were carried on at several properties. The first milling was done in home-made arrastras. It is interesting to note that for the ten years prior to 1911 one man, E. H. Kinder, mined *Pioneer* ore, milled it in a home-made arrastra, and is reported to have made very good wages. Later, milling on some of the properties was done in stamp-mills. At various times mills up to 10-stamp size operated on the *Lorne, Coronation, Pioneer,* and to the south-east on the property of the McGillivray Creek Gold Mines, Limited. This represents the first period of activity.

Between 1917 and 1924 very little was done. The present era of mining and milling was begun at the *Pioneer* and was confined to that property for several years. Credit for getting the *Pioneer* started is due largely to Dave Sloan. The first brick of gold produced from the *Pioneer* mine under his management was poured in 1924. Until about 1928 *Pioneer* used a 30-ton amalgamating mill left by earlier operators, in 1928 a 100-ton cyanide-mill was installed, and in 1932 the mill was enlarged to 300 tons.

Interest in the area grew with the increasing success of the Pioneer Company. Large-scale developments at the other main producer in the region, the *Bralorne* mine, followed those at *Pioneer.* The present *Bralorne* mine includes several former properties, the original being the *Lorne.* Hand-work and milling in stamp-mills had been done on the *Lorne* prior to 1928 when the Lorne Gold Mines, Limited, was incorporated. Large-scale development was begun in 1928, and after a period of inactivity was resumed in 1931. The present company, Bralorne Mines, Limited, was formed in 1931. Milling began late that year, and in 1933 large extensions of the King vein were found, demonstrating the importance of the property.

In the period 1932–35 work was undertaken on many properties, including several on the Bridge River below the mouth of Hurley River. In the period between 1934 and 1937 mills were operated on the *Pioneer, Bralorne, Wayside* (40-100 ton), and *Minto* (50-125 ton) properties. By 1938 mining and milling had stopped at the *Minto* and *Wayside* and prospecting and exploration in the area reached a low ebb.

The main mines, *Pioneer* and *Bralorne,* however, continued production on an increased scale, and in 1939 reached all-time highs in milling, *Bralorne* milling 500 tons and *Pioneer* 375 tons daily. Since then the lack of men and supplies, because of World War II., has caused a falling-off in the mining and milling rates of these mines.

In the McGillivray Creek section, McGillivray Creek Mines milled 390 tons of quartz in 1910, but the recovery was not encouraging enough to invite further milling, and since then little other than some exploratory-work has been done on the property.

The Eldorado Creek and Bonanza Creek sections were actively prospected in 1911 and 1912 and many of the present showings found.

Since then other areas tributary to the main camp have been prospected and development-work has been done on many properties, none of which have become producers.

Geology.

The discussion of the general geology and ore deposits is based largely on information abstracted from publications of the Geological Survey of Canada and Minister of Mines for British Columbia and from papers in technical journals. These are listed in the references on page 34 of this publication. Much of the discussion on the geology and, in particular, nomenclature of the geological formations is based on material in the latest comprehensive reports on the Bridge River area by Cairnes (1937 and 1943). The writer acknowledges these sources of information, but accepts responsibility for generalizations made, particularly those concerning prospecting. The Bridge

River mining area is the most important along the belt and has for that reason been most intensively studied and parts of it have been mapped several times.

The formations, both igneous and sedimentary, trend north-westerly with the trend of the belt, which lies along the eastern flank of the Coast Range batholith. This batholith is a group of intrusives rather than a single uninterrupted batholith. The mineral deposits are distributed in the rocks along the flank and locally are associated with minor intrusives belonging to the general Coast Range group of intrusives.

The various rock formations are described according to their age from oldest to youngest, and under the formation names most commonly and most recently assigned to them. This method makes for an orderly description and the use of formation names will aid the reader when referring to other reports on individual areas or mines.

Palæozoic Rocks.

Fergusson Group.—The oldest rocks in the area comprise the Fergusson or Bridge River series, late Palæozoic in age. They consist of interbedded sediments and volcanics. The sediments are mainly highly contorted, thin-bedded, ribbon-chert with argillite partings between the ribbons. The chert is light to dark grey in colour, the argillite greenish-grey to black. The chert-ribbons range from a fraction of an inch to 3 inches thick; the argillite partings may or may not be thicker than the chert. Short lenses of grey to white limestone are found in the Fergusson series.

Fine-grained, greenish volcanic rocks, ranging from andesites to basalts in composition, are intercalated with these sediments. Amygdaloidal textures and pillow or ellipsoidal structures are common features of the volcanics. Greenstones of the Fergusson series are characterized by the occurrence of small limestone pods from a few inches to 50 feet in length.

Mesozoic Rocks.

The Palæozoic, Fergusson or Bridge River rocks are overlain by Triassic rocks which have been subdivided into a lower group of sediments, the Noel formation, a middle group of volcanics, the Pioneer formation, and an upper group of sediments, the Hurley formation.

The *Noel formation* consists of well-banded argillites and tuffs with only minor amounts of conglomerate, chert, and volcanics. In general they range from light to dark grey in colour.

The *Pioneer formation*, also known as the *Pioneer greenstone*, consists of both extrusive and intrusive rocks. The extrusive or flow-rocks are mainly light to dark green, fine-grained rocks of andesitic composition. Amygdaloidal textures are common but ellipsoidal structures are not. The intrusive phases of the greenstone are very similar lithologically to the flow-rocks. Pyroclastics, ranging from coarse breccias to fine tuffs, have been found associated with the greenstone.

The *Hurley formation* consists essentially of sediments and some volcanics. The sediments include limestones, argillites, tuffs, and conglomerates. As compared with the Noel rocks and the younger Eldorado rocks, the Hurley rocks are distinctly limy. Andesitic flows a few feet thick and irregular bodies of chert are common. A limestone conglomerate is a conspicuous member.

Hurley sediments resemble strata described from the Eldorado series of upper Jurassic and lower Cretaceous age.

The *Tyaughton formation*, lying above the Hurley, consists of sediments which include sandstone, shale, grit, conglomerate, and limestone but no tuffaceous types, and comprises a distinctive assemblage of upper Triassic marine formations.

Sediments above Tyaughton.—A succession of sedimentary rocks with minor amounts of volcanic material lies above the Tyaughton formation. These rocks range

in age from lower Jurassic to upper Cretaceous and include groups which have been recently redefined and named as follows: Taylor, Eldorado, and Leckie groups (Cairnes, 1943).

Members of this younger, mainly Cretaceous, series of sediments and volcanics extend north-westerly from near Tyaughton Lake, past the northern ends of Taseko, Chilko, and Tatlayoko Lakes, and as far at least as Kleena Kleene, a distance of about 120 miles.

The rocks of this late Mesozoic series are relatively unmetamorphosed as compared with the older rocks. They are very similar lithologically, consisting of repeated conglomerate, sandstone, shale, limestone sequences with intercalated volcanics. In many places the different groups can be recognized only by their fossils.

The *Bralorne intrusives*, including the Bralorne diorite and the Bralorne soda-granite, are often referred to in the district as augite diorite. They are important rock-types because they are the host-rocks for gold-bearing quartz veins in the Cadwallader Creek area.

The Bralorne diorite is typically a greyish green, medium-grained rock almost always cut by minute veinlets of such secondary minerals as epidote, zoisite, carbonate, and quartz. In some places the diorite is indistinguishable from the Pioneer greenstone and seems to grade into rock which is definitely Pioneer greenstone. These two rocks are probably closely related in age and origin.

Rocks of somewhat similar appearance and composition, but containing an abundance of quartz, are found closely associated with the diorite. Some of these rocks merge into the augite diorite with indistinguishable contacts and are known as quartz-diorite phases of the diorite. Other areas of these quartz-bearing rocks are definitely intrusive into the diorite and are known as soda-granite. These more acidic rocks are very closely related both in distribution and in origin to the augite diorite. The important gold veins in the district are found in areas where the Bralorne diorite is associated with the quartz-diorite or soda-granite phases.

Diorite stocks similar to those of the Cadwallader Creek gold camp are known (Walker, 1933) to the south-east near the headwaters of Cadwallader Creek and beyond the southern end of Anderson Lake.

Fairly large areas extend to the north-west as far as the eastern end of Gun Lake, and a smaller area of what is thought to be similar rock has been found in the vicinity of the *Lucky Strike* property at the head of Taylor Creek.

The belt of diorite intrusives has a length of at least 28 miles and possibly 34 miles, extending from Anderson Lake on the south to Taylor Basin on the north.

Serpentine.—North-westerly-trending areas of serpentine are common. The serpentine is considered to have formed from ultra-basic rocks such as pyroxenites, peridotes, and dunites. Some areas of relatively unserpentinized ultra-basis rocks are found. In some places the serpentines have been further altered to cream-coloured, carbonate-silica rocks, often mottled with a light green, micaceous mineral resembling mariposite. Although some of the serpentine may be extrusive much of it is intrusive, and where in contact with other rocks the serpentine is usually sheared. The serpentine does not grade into Bralorne diorite but the two rocks may be related.

The *Coast Range intrusives*, in the Bridge River areas known as Bendor intrusives, are light-coloured, massive, medium- to coarse-grained rocks, ranging from granodiorite to diorite in composition, but mainly either granodiorite or quartz diorite. In distribution and general shape of the individual areas the intrusives trend north-westerly with the grain of the country. They intrude rocks ranging in age from Palæozoic to early Mesozoic, and are themselves post-lower Cretaceous in age.

General Discussion.—Metamorphism of the older rocks by the Bendor intrusives is pronounced. The effects are strong for several hundred yards from the contacts and minor effects are noticeable for a mile or so from contacts. The extensive metamor-

phism of contact areas indicates that the Bendor intrusives were particularly juicy and that the metamorphosed rocks are above cupolas. In places rocks of the Fergusson or Bridge River series have been changed to schistose rocks in the contact areas. Knowledge of the results of metamorphism may be of assistance in determining the proximity of the metamorphosed rocks to batholithic rocks, and therefore may be useful in prospecting.

The eastern contact of the main batholith extends north-westerly from Gun Lake. The rocks in this batholith are mainly quartz diorite and granodiorite; however, one large area of white granite has been described from near the head of Bridge River west of Gun Lake (Dolmage 1928, p. 86); this granite intrudes rocks of the main batholith. It is younger than the main body of the Coast Range batholith and may be late upper Cretaceous or Tertiary.

The intrusives along the eastern flank of the batholith are post-lower Cretaceous as deduced from evidence found in the Tatlayoko Lake, Taseko Lake, and Bridge River districts (Dolmage 1925, p. 161).

Areas of Coast Range Intrusives within the Belt.—The areas of Coast Range intrusives adjacent to the eastern flank of the Coast Range within the Anderson Lake-Tatla Lake belt are as follows:—

(1.) An area north-west and south-east of Anderson Lake, 33 square miles in extent.

(2.) An area of granitic rocks lies south-westerly from the headwaters of Cadwallader Creek, the known area as mapped is 23 square miles but its south-western boundary is not known.

(3.) A large area lying north-easterly from the Cadwallader Creek Gold camp, referred to as the Bendor batholith, covering about 51 square miles.

(4.) An area, extending from Mission Mountain north-westerly to Rex Peak, in the Bridge River district, measuring 20 miles in length and 27 square miles in area.

(5.) An area of granodiorite and quartz diorite measuring approximately 3 square miles extends from Taylor basin across to Bonanza basin.

(6.) An area of white granite, 3 miles long, surrounds Lorna Lake at the headwaters of Big (Church) Creek.

The eastern contact of the main Coast Range batholith extends north-westerly from Gun Lake and past the southern end of Taseko Lake. Westerly from this contact the rocks are those which comprise the batholith, mainly quartz diorite and granodiorite.

Minor Intrusives.

Dykes and small intrusives are very common and are of considerable variety. They range from light-coloured acidic to dark-coloured basic rocks, and range in age from Mesozoic to Tertiary.

Tertiary Lavas.

Extensive flows of flat-lying basalt are found easterly and northerly from the area. These lavas are usually highly vesicular and are mainly black basalt. Columnar jointed, amygdaloidal basalt is common. Some tuff is found. In much of the Interior Plateaux region the Tertiary lavas are exposed only above the stream-valleys, forming "rim-rocks."

Small areas of more acid extrusives and associated intrusives of late Cretaceous or Tertiary age have been found in the belt.

Structure.

Except where disturbed by folding and faulting, the rocks, volcanics and sediments, strike north-westerly. The rock units trend, as well as strike, north-westerly.

In places steep, overturned folds and extensive faulting are common.

According to Cairnes (1937) the general structural feature of the Cadwallader Creek-Gun Lake area is a syncline within a major anticlinal arch trending north-westerly. Bodies of Bralorne intrusives and of serpentine have been intruded either along the synclinal axes or along lines closely parallel to these axes. From south to north, from the headwaters of Cadwallader Creek to Gun Lake, the rocks swing from north-west to nearly north, a curvature which roughly parallels the south-western border of the Bendor batholith. Close to the batholith the rocks are closely folded, dip at high angles and may be overturned.

North-westerly from the Bridge River area the general structures are the same, with close folds striking westerly and north-westerly. The less competent beds, such as the argillites, are intensely sheared in places.

Faults are numerous and well-developed in rocks older than the Bendor batholith.

Where detailed work has been done in the Cadwallader Creek section two main groups of faults have been recognized. One group cuts the formations at a small angle and the other group parallels the formation. Cross-cutting faults cut the more competent rocks and displace them as much as several hundred feet. Parallel faults cut the less competent rocks and form shear-zones, along which the aggregate movement has amounted to over 2,000 feet.

These faults are known best close to the Bralorne diorite, partly because underground workings are more extensive there than elsewhere, and consequently opportunities for three-dimensional geological mapping have been better there than elsewhere.

Lode-gold Deposits, Bridge River.

In the following discussion of the lode-gold deposits of the belt the writer will use a modified form of classification used by Cairnes (1937) in describing the Cadwallader Creek deposits. The same classification will be used in describing the deposits along the length of the belt from Anderson Lake to Tatla Lake. Knowledge of the vein types and their rock associations in proven deposits will help the prospector in the search for other gold-quartz veins and in evaluating veins which he finds.

In areal distribution the gold-quartz veins of the district are all associated with igneous intrusives and fall into three groups according to the type of intrusive. Whether the association is because of structural or of genetic relationship is of small importance to the prospector. These groups of veins are as follows:—

(1.) Those found associated with the Bralorne intrusives.

(2.) Those found associated with porphyry dykes.

(3.) Those found associated with areas of Coast Range intrusives.

Deposits, other than lode-gold, include silver-copper veins, antimony-bearing veins, and copper replacement deposits, all associated with Coast Range intrusive rocks. Small amounts of chromium have been found in the ultra-basic rocks. Inasmuch as this is a lode-gold bulletin these deposits will not be mentioned further.

Gold-quartz Veins associated with Bralorne Intrusives.

The distribution of deposits of this type is restricted to areas in which Bralorne intrusive rocks are found. In the following description of the veins of this group the veins on the *Pioneer* and Bralorne mines will be used as typical. As prospecting in the Bridge River area continues other areas of similar rocks and associated veins may be found.

The veins in the Bralorne and *Pioneer* mines are found in and associated with a mass of Bralorne intrusives in which the rocks show a great variation from basic to acidic types. The rocks in the mineralized areas range from augite diorite containing numerous masses of soda-granite to soda-granite almost without rock of other type.

The vein-fissures extend from the augite diorite into the adjoining rocks and the nature of a vein depends on the nature of the wall-rocks. The veins have been persistent in strong, massive, Pioneer greenstone, but much less so in the weaker, thinly

bedded sediments. The veins and vein-fissures have tended to feather out entirely in the serpentine.

Vein-structure.—The vein-bearing fissures related to the main area of Bralorne intrusives on Cadwallader Creek strike east-west and lie partly within and partly without the north-westerly-striking masses of these intrusives.

The veins dip northward. Movement along them has been such that the northern side moved westerly, the displacement ranging from a few to several hundred feet. The veins are cut by northerly-trending faults, which dip eastward and westward; on these the western side has moved northerly up to 400 feet. In the Bralorne mine the faults are hinge faults, with the centres of rotation near the surface.

The veins tend to be well-defined, fairly regular and steep, in the more massive rocks such as the augite diorite, soda-granite, and Pioneer greenstone, but are tight and poorly defined in the sediments, particularly if the sediments are thinly bedded, and lie at a small angle to the strike of the fissure. In schistose greenstone and in serpentine the fissures tend to split and to die out.

The veins associated with the Bralorne intrusives are lenticular. The pinching and swelling is proportional to the variation in strike and dip. Concerning the continuity of veins, Cairnes (1937, p. 52) wrote in part: "At places, where the fissures curve along their strike or dip, widths of as much as several times the average may occur, whereas at other places the vein-matter may pinch to a small fraction of its normal size. Such features are characteristic of vein-bearing fissures that are not straight and along which faulting has occurred. A pinching of a vein need not in consequence necessarily discourage further exploration, especially in a fissure that has elsewhere yielded substantial vein deposits. Where, however, a fissure occurs in, or passes into, less competent formations and develops greater widths of sheared ground at the expense of cleaner fissuring, vein-matter is generally discontinuous. As a rule the vein deposits are essentially continuous where fissuring is well defined and become discontinuous where shearing predominates."

The vein-matter tends to be abundant only where the fissure is well-defined, and less abundant and discontinuous where the breaks are weak and become dissipated into a number of closely spaced shears.

Vein-matter.—The vein-matter consists mainly of milky-white quartz with only small amounts of the metallic minerals, up to 3 per cent. sulphides have been estimated.

A conspicuous feature of the veins in the Bralorne and *Pioneer* mines is the ribboning parallel to the strike and dip of the vein. In such material, the quartz ribbons, ranging up to several inches in thickness, are separated by thin, dark grey, films of ground-up sulphides, sericite, white mica, and gouge, and occasional slickensided free gold. The vein breaks readily along these films and often reveals striated walls of quartz, or small areas of striated sulphides. Ribbon structure is due to movement that occurred within the vein in part, and in part after formation of the vein. It may be confused with a sheeted structure of later formation, where both the vein and wall-rock are equally affected.

The gangue minerals include mainly quartz, locally abundant calcite, and minor amounts of sericite, chlorite, mariposite, scheelite, dolomitic and ankeritic carbonates. Of these, mariposite (a chrome-potash mica) is conspicuous, not so much because of its abundance, but because of its brilliant green colour and flaky habit. At various times during the history of the Bridge River camp mariposite has been used as a criterion of a promising gold-quartz vein, but more complete information has shown that many of the veins have the requisite mariposite but very little gold. Statistics of association of mariposite with gold-bearing quartz show that the presence of the mineral can not be used indiscriminately as indicative of a good gold vein. Scheelite, usually widely scattered, has been found in a great many of the gold-quartz veins. In the Bralorne mine a small shoot of vein-matter, rich enough to be called tungsten ore, was found.

Although they make up a small part of the vein-matter, eleven or more metallic minerals are found, including native gold, arsenopyrite, pyrite, chalcopyrite, galena, sphalerite, stibnite, tetrahedrite, marcasite, and a telluride, thought to be either sylvanite or calaverite.

The native gold is frequently scattered indiscriminately in white quartz, but is also found with sulphides. Arsenopyrite is commonly associated with gold, but both sphalerite and galena are also mentioned as common associates.

Wall-rock Alteration.—Fresh and altered wall-rock may be observed in many places. The alteration varies from slight to intense. Its recognition is important, in that its presence, particularly where intense, indicates that a large volume of mineralizing solutions has travelled along the vein-fissure. The evidence of the passage of these solutions increases the probability that gold also travelled and was deposited in the fissure.

Wall-rock alteration usually means a bleaching of the rock adjacent to vein-fissures for distances ranging from a few inches to several feet. The intensity and nature of wall-rock alteration depends on both the nature of the altering solutions and on the character and composition of the rocks.

In general, the Bralorne intrusives and greenstones have been more altered than the sediments. Carbonatization has been the dominant process, with up to 75 per cent. of the greenstone being altered to ankeritic carbonate. Fine, scaly micas are characteristic, white sericite mica in the acid rocks, and mariposite in the more basic types. Disseminated pyrite crystals are characteristic of altered wall-rock. Some of the altered phases of augite diorite and the greenstone, immediately adjacent to the veins, are very difficult to tell from similarly altered albitite dykes. The term albitite has been used in describing dykes and what may or may not be merely altered wall-rock, thereby leading to much confusion.

Outcrops of altered wall-rock are usually stained brown or rusty because of the oxidation of the abundant ankeritic carbonate in the altered phase.

The alteration of serpentine by vein-solutions is very conspicuous and common. It should be mentioned, however, that the alteration is not always present near veins. The alteration has been complete over large areas and the serpentine in the altered areas changed from a blackish green rock to a light cream-coloured rock speckled with flecks of brilliant green mariposite; weathered outcrops are usually a deep reddish-brown. The altered serpentine consists of ankeritic carbonate cut by a network of veinlets and irregular masses of milky-white quartz, the whole flecked with brilliant green mariposite.

Examples.—Veins of the first group (associated with Bralorne intrusives), found on the *Pioneer* and Bralorne properties and on most of the smaller properties near-by, are related to the main area of Bralorne intrusives. Veins on some of the properties on McGillivray Creek are close to hornblende diorite intrusives that are somewhat similar to the Bralorne intrusives. North of the Cadwallader Creek section veins on the *Wayside*, *B.R.X.*, *Bridge River Consolidated*, and *Veritas* properties are related to areas of augite diorite differentiated in part to granitic phases that are comparable to the Bralorne intrusives up Cadwallader Creek.

Gold-quartz Veins associated with Porphyry Dykes.

Many veins are found close to and in dykes and small irregular masses of feldspar porphyry and hornblende porphyry where the porphyries cut massive rocks such as greenstone or even highly altered serpentine. In the Bridge River area the porphyries are found mainly in massive greenstone of the Fergusson or Bridge River series which lie north-easterly from the north-westerly-trending line of the Bralorne intrusives and easterly margin of the Coast Range batholith. These porphyries are undoubtedly closely related in time of origin to the Coast Range intrusives.

The mineral deposits consist of veins in fissures accompanied in part by extensive replacement of the wall-rock. The formation of such veins is favoured by a rock which will fracture well and be readily replaceable by mineralizing solutions. Massive greenstone, rather than bedded sediments, particularly thin-bedded sediments, best fits these requirements.

As contrasted to the Pioneer-Bralorne type of vein, the fissure-veins related to porphyry dykes are characterized by a high percentage of sulphides in the quartz. The replacement veins, either where the vein is formed wholly by replacement or where it is formed in part also by fissure-filling, are characterized by dense ankeritic carbonate and finely disseminated, small crystals of pyrite and arsenopyrite. Quartz and stibnite are conspicuously absent from replacement masses.

Examples.—Gold-quartz veins, many characterized by heavy sulphides, that are in or close to porphyry dykes are found on the properties up Cayoosh Creek, on the *Congress, Dauntless, Kelvin, Olympic,* and *Peerless* in or close to the Bridge River, and on the *Lucky Strike* in Taylor Basin. The country rock, apart from the porphyry dykes, is massive greenstone on most of these properties.

Gold-quartz Veins associated with Coast Range Intrusives.

This group includes a wide range of mineral and structural types. Structurally most are wholly filled fissure-veins or veins which may be filled fissures, but are accompanied by much replaced and mineralized wall-rock. Mineralogically the deposits consist mainly of quartz gangue with abundant sulphides; the sulphides antimony and cinnabar are absent. The proportion of sulphide to gangue is usually much higher than in the Pioneer-Bralorne type of vein. The *Pilot* property on Gun Lake, where sulphide-poor quartz veins are found in the batholith, is an exception.

Disseminations and small lenticular masses of sulphides are found near the borders of the intrusions, as on the *Gem* on Roxey Creek, where lenses of cobalt-sulphides carrying a little gold are found.

Examples.—Veins either in or close to areas of Coast Range intrusives are found at many places in the belt. In the Bridge River area they are found at the *Pilot, Bridge River Pacific, Gem, Jewel, Lucky Gem, Northern Light,* and *Robson,* as well as on some antimony-gold properties such as the *Congress, Golden,* and *Reliance.* The veins on these properties are rarely more than 2½ miles from the contact and tend to be farther on the greenstone-sediment than on the granite side of the contact.

Suggestions for Prospecting.

Although the Cadwallader Creek-Bridge River section has been rather well prospected and covered by many claims, more intense prospecting of the staked ground by the owners or optionees of the claims may well be advisable. Much of the ground is covered by a heavy mantle of drift, and it is probable that on such ground only diamond-drilling or actual underground work will yield further discoveries of productive veins.

The area north-westerly from Bridge River, from Gun Lake to the basin areas at the heads of Taylor, Tyaughton, and Bonanza Creeks, offers the best chances in areas that are neither covered by drift nor as thoroughly prospected as the Cadwallader Creek section. Search should be made for the three types of gold-quartz veins previously described, bearing in mind that the most important veins in the area have been found in "augite diorite." The general suggestions about favourable prospecting areas given on pages 10 and 11 of this bulletin hold here as well as elsewhere.

Search should be made for those Bralorne intrusives characterized by areas of rocks which show a marked variation from dioritic to granitic rocks. The best veins have been found where the rocks range from augite diorite containing numerous areas of granitic rocks to areas consisting almost wholly of granitic rocks (soda-granite).

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MINERALIZED AREAS NORTH-WESTERLY FROM BRIDGE RIVER.

Because they are generally less known, brief descriptions will be given of properties in areas north-westerly from and separate from the more thoroughly prospected Bridge River area. Proceeding north-westerly veins, in or at no great distance from bodies of Coast Range intrusives (granitic to dioritic), have been found on the *Taylor-Windfall* on upper Taseko River, on the *Hi Do* south of Taseko Lake, on the *Morris* south of Tatlayoko Lake, and on properties in the Blackhorn Mountain and Perkins Peak sections. Veins on the *Vick*, *Viccal*, and *Mary Stuart*, north of Taseko Lake, are in or close to diorite and feldspar porphyry.

Taseko Lake.

There are several prospects in the vicinity of Taseko Lake, north of the Bridge River district, and a little gold has been produced from the Taylor-Windfall property, on upper Taseko River south-easterly from the lake. This section is accessible by road and boat from the north via Williams Lake and Hanceville and from the south by pack-trails over high passes from Gun and Tyaughton Creeks, in the Bridge River district, to the head of Taseko River and down the latter to the southern end of Taseko Lake.

Access to the Taylor-Windfall property from Hanceville, 60 miles west of Williams Lake, is by way of 55 miles of poor motor-road to the northern end of Taseko Lake; thence by water 9 miles southerly to the narrows, from which 12 miles of road to the property was built in 1939. By pack-horse trail, usable in the summer months, the distance from the Bridge River is 38 miles. On this property some gold was recovered from rich gold-bearing eluvium, discovered in 1920 on the hillside sloping into Battlement Creek; and some gold has been recovered by milling ore from small but rich gold-quartz veins (or pockets) found in tuffs close to quartz-diorite. No production has been recorded since 1934.

Several low-grade copper prospects are found in the Coast Range intrusives just north-west of the Taylor property.

At the *Hi Do* property, discovered in 1936, west of the Lord River, a few miles south of Taseko Lake, gold-bearing quartz veins strike north-east and dip steeply in the granodiorite which here trends easterly.

At the *Vick*, about half a mile northerly from the northern end of Taseko Lake, south-westerly-striking fissure-veins up to 20 inches wide, are found associated with diorite dykes in andesites and tuffs. The vein-matter consists of quartz mineralized with small amounts of chalcopyrite and pyrite. High gold assays have been found but little work has been done on the showings.

On the *Viccal* and *Mary Stuart* groups, 10 miles north of Taseko Lake, pyrite veinlets, carrying low values in gold, are found in diorite and in feldspar porphyry.

Tatla Lake.

Tatlayoko Lake, Blackhorn Mountain, and Perkins Peak.

In three sections accessible from Tatla Lake Post-office, gold-bearing veins have been found and have been explored by surface and some underground workings. The three sections are in the eastern part of the rugged Coast Range and each is no more than a few miles from the eastern contact of the Coast Range batholith. The discoveries on Blackhorn Mountain were made about 1936, discoveries in the other sections were earlier, some in the Tatlayoko Lake section were made in 1907.

A motor-road running westerly from Williams Lake reaches Tatla Lake Post-office in a little less than 150 miles. A pioneer road continues north-westerly passing through Kleena Kleene, on One Eye Lake, about 15 miles from Tatla Lake. From Kleena Kleene trails running south-westerly reach Perkins Peak about 20 miles distant. The route from Tatla Lake to Blackhorn Mountain follows a local road for about 15 miles to the northern end of Bluff Lake, from which a pack trail about 17 miles long is followed southerly. The northern end of Tatlayoko Lake is reached by a local road 24 miles long, which leaves the main road a short distance easterly from Tatla Lake.

Tatlayoko Lake.

Morris's property, about 3 miles south-easterly from the southern end of Tatlayoko Lake. Several veins have been found in argillaceous rocks not more than 400 feet from the margin of dioritic bodies and in the dioritic bodies themselves. Sulphide minerals found in the vein consist principally of stibnite, arsenopyrite, and pyrite, in that order

of abundance, with minor amounts of sphalerite and tetrahedrite. The averages of samples taken by O'Grady (1935, p. F 32), representing short to moderate lengths of the No. 1 vein, ranged from: Width, 2 feet 8 inches—Gold, 0.18 oz. per ton, silver 1.5 oz. per ton; to width, 3 feet 6 inches—Gold, 0.38 oz. per ton, silver 3.0 oz. per ton.

The *Langara*, *Standard*, and *Argo* groups are 9 to 10 miles by trail north-westerly from the southern end of Tatlayoko Lake. Several veins have been found in diorite and metamorphosed siliceous sediments, and replacement deposits in metamorphosed argillites. The veins range from a few inches to 5 feet in width, and the replacement deposits to 11 feet. Sulphide minerals include pyrite and arsenopyrite, and on the *Argo* galena, sphalerite, chalcopyrite, and pyrrhotite are also found. Assays quoted by O'Grady (1935) from veins on the *Langara* ranged: Gold 0.9 to 0.18 oz. per ton, silver 0.4 to 8.2 oz. per ton; and from replacement deposits on the *Standard*: Gold 0.36 to 0.44 oz. per ton, silver trace to 0.6 oz. per ton. Little work had been done on the *Standard* and *Argo*.

Blackhorn Mountain.

(O'Grady, 1937, pp. F 3–F 6; Sargent, 1938, pp. F 29–F 38).

In this section work has been concentrated on Blackhorn Mountain, which is on the western side of the upper part of Razor (Wolverine) Creek. The rock exposed consists principally of thin bedded black argillites, overlain by green conglomerate, overlain in turn by greenstone. The three members are cut by numerous granitic dykes and sills. Parts of the conglomerate are schistose and parts of it and of the greenstone are represented by sericite schist. For 1,000 feet along the strike the argillite is interrupted by massive greenstone. The sediments strike north-westerly and dip south-westward at small angles. Numerous quartz stringers and lenses are found generally in the schistose sediments just below greenstone, in a distance of about 3 miles along the strike. Much of this quartz is barren but at some points it carries visible gold. Samples from points where sulphides are present have yielded moderate assays in gold. Galena, sphalerite, chalcopyrite, and arsenopyrite are found in quartz. Some of the quartz-lenses reach widths of as much as 6 feet. Much of the quartz is barren; more promising showings carry values which range from 0.15 to about 1.5 oz. of gold per ton. A vein from 1½ to 2½ feet wide, in the adit-level on the property of Homathko Gold Mines, Limited, appeared to have a chance of continuing downward in massive greenstone.

Perkins Peak.

The rocks of this section include easterly-striking and southward-dipping sandstones and argillites cut by much-altered basic dykes.

On the *Mountain Boss* property (Sargent, 1938, pp. F 38–F 41) quartz-lenses have been found in shear-zones that strike easterly and dip southward with the bedding of the enclosing argillites and quartz veins have been found cutting silicified sandstone. Arsenopyrite and a little pyrite are found as lenses in the silicified zones and in vein-quartz. The contact of the batholith, striking north-easterly, lies about 2 miles north-westerly. Very little underground work has been done. The bedded veins in weak and incompetent sediments do not lend encouragement to prospecting, but higher grade mineralization in veins cutting silicified sandstone is more promising.

Suggestions for Prospecting.

Much of the country along the eastern flank of the Coast Range north-westerly from Bridge River is extremely rugged; consequently transportation is difficult, costly, and time-consuming, reducing time and money available for actual prospecting in the area.

The several mineralized areas are found at widely scattered places along this north-westerly part of the belt, and therefore the best place to start prospecting is

from one of the several mineralized areas and work along the general contact-zone of the batholith, preferably in areas of greenstone, rather than of sediments.

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MINERALIZED AREAS EASTERLY AND SOUTH-EASTERLY FROM BRIDGE RIVER.

Cayoosh Creek.

The Cayoosh Creek area is about 12 miles by motor-road south of Lillooet.

As it is convenient to Lillooet, the area was prospected very early in the gold-mining history of the Province. Following placer-mining on Cayoosh Creek, shortly after the discovery of placer at Lillooet in 1859, lode gold was found in vein-quartz on the *Bonanza* claim in 1887. Since then other properties have been intermittently prospected but without much success. The only production recorded from the area was from the *Golden Cache* (*Ample*) between 1897 and 1901, when about 3,000 tons of ore, treated in a 10-stamp mill, yielded 807 oz. of gold or 0.26 oz. per ton. Work has been done on the *Bonanza Cache* and *Golden Cache*, relatively old properties, and on the *Morning Glory* and *Marygold*, staked in the '30's.

The deposits consist of gold-quartz lenses and stringers which are bedded with north-westerly-trending argillites. Carbonaceous to limy argillites predominate in the region, but in places they are cut by dykes and sills of diorite (possibly quartz diorite) and hornblende diorite. The nearest known area of Coast Range batholithic rocks lies 10 miles westerly on Lost Creek, where an area of quartz diorite 33 square miles in area extends north-westerly across Anderson Lake.

The veins contain mainly quartz mineralized with small amounts of pyrite.

Considerable underground work has been done on the *Bonanza Cache* and the *Golden Cache* but the veins have so far not proven large enough or of sufficiently good grade to mine profitably.

Suggestions for Prospecting.—The numerous lenses of mineralized quartz that have been found afford evidence that mineralizing solutions permeated the area. So far the discoveries have been lenticular lenses and veins that follow the bedding of the argillites, and no vein-filled fissures crossing the bedding have been found. The argillaceous rocks have proven too weak to carry strong, clean-cut breaks and it is suggested that areas of more competent rocks such as greenstone be sought for and those areas prospected for veins.

The rocks in the area have been mapped mainly as sediments. They may represent the south-easterly continuation of the Fergusson-Bridge River series from the upper Bridge River. In the upper Bridge River this series contains massive greenstone and it is possible that the same group of rocks in the Cayoosh Creek area may also carry some greenstone. Inasmuch as greenstone is a more favourable host-rock than sediments for the formation of veins, an area in which it is found is more favourable for prospecting than an area consisting wholly of sediments.

Duffey Lake.

Quartz-tetrahedrite veins carrying up to a few hundred ounces of silver per ton have been found near Duffey Lake, about 20 miles easterly by trail from the south end of Anderson Lake. The gold content is insignificant.

Occurrences of granitic rocks mineralized with disseminated molybdenite near the headwaters of Texas Creek represent the north-easterly limit of known mineralization in the general Anderson Lake-Tatla Lake belt.

Little is known about the mineral possibilities of the very mountainous and relatively inaccessible country which extends south-easterly to the Fraser River. The lack of information about mineralization may be because of the lack of prospecting.

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AREA EAST OF THE COAST RANGE.

ANDERSON LAKE TO KAMLOOPS LAKE.

Few gold properties appear to have been found between the Anderson Lake-Tatla Lake belt and the Vidette Lake area. The *Grange* (*Big Slide*) mine, on the Fraser River, 30 miles north of Lillooet, is the only one on which much work has been done.

At the *Grange* mine a lenticular quartz vein in a small stock of granitic rock has been explored in underground workings and there has been some production at different times, but the values are apparently too low for successful operations. This is one of the oldest lode-gold properties in the Province. It was discovered by an Indian in 1872; in 1881 an arrastra was built, followed in 1886 by a 10-stamp mill which operated for only three to four months. The mine was closed down in 1887. It was reopened in 1928, and after underground exploration a 25- to 50-ton mill was built in 1934, but only operated for about a year. Since 1934 very little work has been done on the property.

VIDETTE LAKE.

LOCATION AND ACCESS.

The Vidette Lake Camp may be reached by 43 miles of automobile-road northward from Savona, a small settlement at the western end of Kamloops Lake on the Cariboo Highway, the Canadian Pacific and the Canadian National Railways.

HISTORY.

The main properties in this camp were staked in 1931 and 1932. Development-work followed immediately. A small mill built on the *Vidette* in 1932 was enlarged to 50 tons daily capacity in 1933. Operations continued on the properties of the Savona Gold Mines, Limited, and Hamilton Creek Gold Mines, Limited, until 1938. Mining and milling continued on the *Vidette* until 1940, when the mine was closed and the plant and equipment were put up for sale.

Production.

The production in the area, mainly from the *Vidette* mine, has amounted to slightly more than 54,000 tons, averaging a little more than ½ oz. of gold per ton.

Mineralized Area and Properties.

The developed area is at the north-western end of the lake and includes the property of the Vidette Gold Mines, Limited, immediately adjacent to the lake; that of Savona Gold Mines, Limited, the workings of which are in a direction north 20 degrees west from the head of the lake; and that of the Hamilton Creek Gold Mines, Limited, whose workings are on the Hamilton Creek scarp south-westerly across the valley from those of the Savona Gold Mines. These companies have driven adits and inclines into the steep valley-walls bordering Hamilton Creek and Vidette Lake, whose common valley has been sharply incised to depths ranging from 250 to 400 feet in the extensive Bonaparte-Tranquille Plateau.

Geology and Mineralization.

The rock formations include greenstone, small stocks and dykes of feldspar porphyry, and, on the plateau above and beyond the workings, basaltic lavas.

The granitic rocks found both on the surface and underground at the *Vidette* and Savona properties may be called feldspar porphyries.

The veins are of the quartz-filled fissure type, and may or may not be accompanied by extensive shearing of the wall-rock. They range from a knife-edge to 4 feet wide, and all strike north-westerly and dip north-eastward. Mineralization has resulted in the development of pyrite, smaller amounts of chalcopyrite, and reported tellurides; gold frequently accompanies the above minerals, local experience indicating that the values are best where chalcopyrite accompanies the pyrite. Replacement of the wall-rock, though undoubtedly present, is not important, and leaching of the wall-rock is rare, dark-green andesite being commonly in immediate contact with the quartz veins.

Faulting of varying ages is prevalent. Pre-vein fissuring, intro-vein faulting, both during and after the mineralization period, and post-vein, transverse faulting, are all present.

Suggestions for Prospecting.

Vidette Lake, in the region of the Interior Plateaux, occupies the largest valley in the vicinity, and one of the few places where incision has exposed the underlying greenstones or granitic rocks. Except where valleys have been incised through the lava-flows, lava and drift mask the underlying rocks in most of this area. The chances of finding exposures of greenstone and granite outside of the Vidette Lake-Deadman River valley are few, because there are few other valleys of comparable size. However, a few prospects have been found at isolated places on the plateau east of Vidette Lake, where the bed-rock is not completely covered by lava. Because of the isolated nature of the greenstone and granite exposures, the only suggestion that can be made is to search for these exposures in the hope that the ones found may contain veins.

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HIGHLAND VALLEY (SOUTH-EAST OF ASHCROFT).

Highland Valley, about 20 miles south-east of Ashcroft, is an area of copper mineralization, but the accompanying gold values, even when present, are too low to be of any importance. The copper production has been small. At least eight properties have been found within a radius of 10 miles of the divide between Pukaist and Witches Creeks. The ground has therefore been fairly thoroughly prospected and copper and some molybdenum found, but no gold mineralization.

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